3.5 Constructing a Mach-Zehnder Interferometer

Objective:
Learn to construct a Mach-Zehnder interferometer and observe the interference phenomena

Experimental Setup

Figure 5-1 Photo of experimental setup

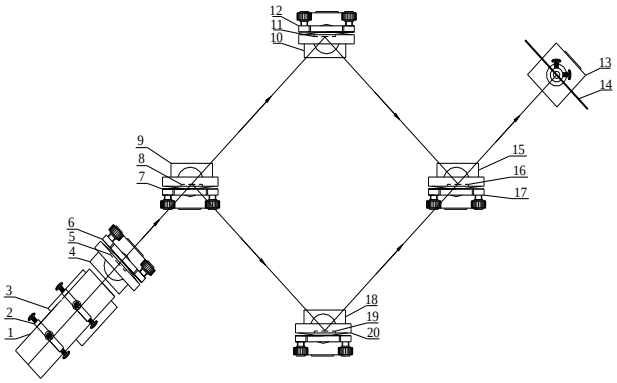

Figure 5-2 Configuration of components

Note: Photos may vary from actual parts

1: He-Ne Laser L (LLL-2)
2: Laser Holder (SZ-42)
3: X-Trans Carrier (LEPO-54-3)
4: Beam Expander (*f'*=15 mm)
5: Lens Holder (SZ-08)
6: X-Z-trans Carrier (LEPO-54-4)
7: Beam Splitter (5:5)
8: Two-axis Tilt Holder (SZ-07) or Plate Holder (SZ-12)
9: Carrier (LEPO-54-2)
10: Flat Mirror
11: Two-axis Tilt Holder (SZ-07)
12: Carrier (LEPO-54-2)
13: Magnetic Base (SZ-04)
14: White Screen (SZ-13)
15: Beam Splitter (5:5)
16: Lens Holder (SZ-08)
17: Magnetic Base (SZ-04)
18: Flat Mirror
19: Two-axis Tilt Holder (SZ-07)
20: Magnetic Base (SZ-04)

Principle

Mach-Zehnder interferometer (MZI) is also derived from Michelson interferometer. It is used for studying the change in the wave front when the light wave passing through an object of interest. T schematic diagram of the Mach-Zehnder interferometer is shown in Figure 5-3. The light beam from a He-Ne laser is first divided by a beam splitter BS_1 into two beams of equal intensity. After reflected by mirrors M_1 and M_2, the two beams are recombined via a second beam splitter BS_2. Then the interference pattern will be observed on a view screen.

A MZI is frequently used in the fields of plasma physics, aerodynamics, and heat transfer for the measurement of density, pressure, and temperature changes in gases.

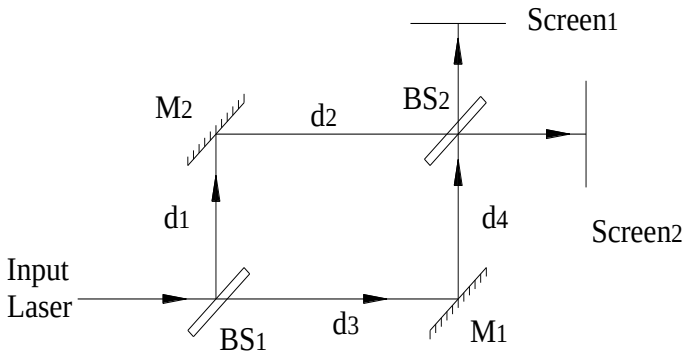

Figure 5-3 Schematic of Mach-Zehnder interferometer

Experimental Procedure

1. Refer to Figure 5-2, align all components in same height on the optical rail. At the moment, beam expander should not be included in the light path;
2. Adjust the output of the He-Ne laser to make it parallel to experimental table (and along the optical rail if applicable);
3. Adjust beam splitter BS_1 at an angle of 45° with respect to the beam axis, and adjust its tilt so that the two beams (transmission and reflection) are parallel to the table;
4. Adjust mirrors M_1 and M_2 until the light beams reflected by them strike at same position on BS_2;
5. Put in the beam expander, interference pattern will be observed on the screen;
6. Clap the experimental table and see any changes of the interference pattern.